Claims

1 An image sensor element comprising a semiconductor substrate, a radiation transparent insulating layer formed on the semiconductor substrate, an electrode formed as a layer of transparent resistive material on the insulating layer, a first contact adjacent to one edge of the resistive layer, a first diffusion region in the semiconductor substrate of opposite conductivity to the semiconductor substrate located adjacent to the first contact and biassed to a higher potential than that of the first contact, a second diffusion region is the semiconductor substrate of opposite conductivity to the semiconductor substrate located adjacent to the second contact and biassed to a higher potential than that of the second contact, means for applying an electrical potential between the first and second contacts, and means for reading out the charge on the first and/or second diffusion regions.

2 An image sensor element as claimed in Claim 1 wherein the resistive layer is rectangular.

3 An image sensor element as claimed in Claim 2 comprising four contacts each having a diffusion region adjacent thereto.

4 An image sensor element as claimed in Claim 3 in which the contacts are arranged one at each side.

5 An image sensor element as claimed in Claim 3 in which the contacts are arranged one at each corner.

6 An image sensor element as claimed in Claim 3 in which two contacts are arranged on each of two opposite sides.

7 An image sensor element as claimed in any of Claims 2 to 6 in which the resistive layer is square.

8 An image sensor element as claimed in any preceding claim in which the insulating layer is between 1nm and 1μm thick.

9 An image sensor element as claimed in any preceding claim in which the electrode has a sheet resistivity of greater than 10Ω/square.

10 An image sensor element as claimed in any preceding claim in which the photosensitive part of the element is implemented in a semiconducting layer at the surface of the substrate, the surface semiconducting layer being of opposite conductivity to the substrate, the element further comprising means for biassing the surface semiconducting layer so that it is fully depleted.

11 An image sensor element as claimed in any preceding claim in which the read out means is implemented as a source follower with a pixel select transistor.

12 An image sensor element as claimed in any of Claims 1 to 10 in which the readout means is implemented as a resettable charge amplifier with a pixel select transistor.

13 An image sensor element as claimed in any Claims 1 to 10 in which the readout means is implemented as a

transconductance amplifier, for measuring the photocurrent at the first or second diffusion regions, with a pixel select transistor.

14 An image sensor element as claimed in any Claims 10 to 13 in which the readout means is implemented in the surface semiconductor layer, the surface semiconductor layer is arranged to be connected to ground potential, and the semiconductor substrate is arranged to be connected to a potential such as to produce a deep depletion layer in the semiconductor substrate.

15 A device for the detection and demodulation of a modulated wavefield comprising an image sensor consisting of a one or two dimensional array of image sensor elements, each image sensor element being an image sensor element as claimed in any of Claims 1 to 14; a signal generator for supplying time dependant voltage patterns to the contacts on each of the image sensor element electrodes in synchronism with the modulation frequency of the incident wavefield to transport photocharges laterally to the corresponding diffusions on which photocharges are accumulated; and readout means for reading out the charges on the diffusions for use in calculating the modulation parameters of the incident modulated wavefield.

16 A device as claimed in Claim 15 in which photocharges are accumulated over a plurality of periods of the modulation frequency of the incident wavefield.

17 A device as claimed in Claim 15 or Claim 16 in which each period of the modulation frequency is

divided into a number of time intervals; wherein a separate contact and diffusion region is provided in each image sensor element for each time interval.

18 A device as claimed in any of Claims 15 to 17 comprising an evaluation unit for calculating the modulation parameters of the incident wavefield from the charges readout from the diffusions.

19 A method of detecting and demodulating modulated wavefields comprising the steps of:

a) illuminating the array of image sensing elements of a device according to any of Claims 17 to 20 with the modulated wavefield;

b) dividing each period of the modulation frequency into a number of intervals;

c) providing a separate contact and corresponding diffusion region for each time interval;

d) transporting photoregenerated charge to the corresponding diffusion regions during each time interval and storing them therein;

e) reading out the stored charges from the diffusion regions; and

f) calculating demodulation parameters from the charges readout from the diffusion regions

20 A method as claimed in Claim 19 in which charges are accumulated in the diffusion regions over more than one period of the modulation frequency.

21 A method as claimed in Claim 19 or Claim 20 in which the wavefield is directed onto the array by optical elements.

22 A method of determining the three dimensional shape of reflective object comprising the steps of:

a) illuminating the object with a modulated light source;

b) imaging light reflected from the object onto an array of image sensor elements of a device as claimed in any of Claims 17 to 20 to form a two dimensional intensity modulated wavefield whose local phase represents local distance from the object to the detection device;

c) dividing each period of the modulation frequency into a number of time intervals;

d) providing a separate contact and corresponding diffusion region for each time interval;

e) transporting photoregenerated charge to the corresponding diffusion regions during each time interval and storing them therein;

f) reading out the stored charge from the diffusion regions;

g) calculating the local phase of the modulated wavefield incident on the array; and

h) using the local phase information to determine the three dimensional shape of the object.